

No. 7. — *Notes on some Species of Drawida and Pheretima with  
Descriptions of Three New Species of Pheretima*

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INTRODUCTORY NOTE

This paper presents some of the results of an examination of certain earthworms from three American museums, the Museum of Comparative Zoölogy in Cambridge, the American Museum of Natural History in New York, and the United States National Museum in Washington; and from two European Museums, the British Museum in London and Das Zoologische Museum in Hamburg. The writer is indebted to Dr. Van Name, Dr. Waldo Schmitt, Dr. C. C. A. Monro, and Dr. W. Michaelsen for the opportunity of studying the specimens from their respective institutions. To Dr. Thomas Barbour,

Director of the Museum of Comparative Zoölogy, the writer is especially indebted for the courtesy of accommodation in the museum during the winter of 1934-35.

Attention has been directed in previous papers to the advisability of dissecting off the cuticle in order to enable more accurate description of the genital markings and other external characteristics. Removal of the cuticle, may, of course, be difficult especially on hardened and brittle alcoholics. But it is often on just such specimens that important markings are rendered indistinct or even actually invisible by the presence of the cuticle. To illustrate the value of this dissection two descriptions, one written before, the other after removal of the cuticle are quoted herewith.

"The male porophores are transversely oval, not sharply demarcated and extend at least to 17/18 and 18/19" (before removal of cuticle). "The male porophores are transversely oval, slightly protuberant, definitely demarcated by a slight, circumferential furrow and extend nearly but not quite to 17/18 and 18/19" (after removal). It should be noted that exactly the same magnification and illumination was used in obtaining both of these characterizations.

### Genus DRAWIDA Michaelsen

*Drawida* Michaelsen 1900, Das Tierreich, **10**, p. 114. (Genotype, *Moniligaster barwelli* Beddard, 1886.)

### DRAWIDA BARWELLI (Beddard)

*Moniligaster barwelli* Beddard, Ann. Mag. Nat. Hist. Ser. 5, **17**, p. 94, 1886; Zoöl. Anz. **10**, p. 678, 1887; Quart. J. Mic. Sci., **29**, p. 119, 1888; Trans. R. Soc. Edinburgh, **36**, p. 2, 1891; Monog. of the order Oligochaeta, Oxford, p. 200, 1895 (excluding *M. beddardi*.)

*Drawida barwelli* Michaelsen 1900 (part), Das Tierreich, **10**, p. 116. (Excluding *M. beddardi* Rosa and *M. species* Horst.)

In 1900 when Michaelsen split off from *Moniligaster* the species with simple spermathecal atria to form the genus *Drawida*, *M. barwelli* was designated as the type of the new genus. Since that time worms from such widely separated localities as the Caroline Islands, Lombok and diverse regions of India have been referred to this species. As the genotype and also because of its unusually wide distribution (for a *Drawida*) the species is of considerable interest and importance.

*M. barwelli* was erected on a series of twenty acitellate specimens from Manila, P. I. In the period from 1886 to 1891 all of the types were either dissected, sectioned or mounted. Whether any of these specimens are still in existence, and if so, in condition to permit study, is unknown.

At the time (1886) there was known only one other species of *Moniligaster*, *M. deshayesi* E. Perrier 1872, and from the latter, *M. barwelli* was supposed to be distinguished by the smaller size and the lack of an anterior pair of testes. Both of these distinctions are, however, of no importance at the present time. The original description furnishes the following information.

Length, not more than  $1\frac{1}{2}$  inch. Setae closely paired. Male pores, "two oval slit-like orifices with tumid yellowish lips which are the male generative orifices, and are situated between segments 9 and 10 between the ventral and dorsal pairs of setae." (p. 95). Four gizzards, "in one specimen at any rate." Spermathecae in vii, without atria, "opening onto the exterior in front of the outermost pair of setae" (!). Testes in ix or in septum 8/9. From figure four (pl. 3) it would appear that the vas deferens is usually short, that the male pores (?) are in *bc* slightly nearer to *b* than *c*, and that the prostates are sessile.

In a later paper ('87) Beddard again states that the male pores are in 9/10 but the spermathecal pores are now definitely placed in 6/7. The testis sacs, previously called testes, are referred to as receptacula seminis or seminal vesicles. The prostate is said to be "a small oval body," "lined throughout with a single layer of glandular looking cells, outside which are several layers of muscular fibres and outside these again peculiarly modified peritoneal cells."

In a third paper ('88) the prostate is said to have a large lumen and "the external covering is composed of numbers of large granular cells which are separated into groups by partitions." In figure 12 (pl. 12) an oviduct is shown opening to the exterior on *x* directly behind a seta (!).

In the fourth paper ('91) Beddard points out that he had previously failed to notice the setae of segment ii which are said to be smaller than those of succeeding segments and as a result segments i and ii had been regarded as one segment. A few additional bits of information are included in this paper. Diameter, one tenth of an inch. "The only apertures upon the outside of the body are the atrial pores in segment *x*" (spermathecal pores? dorsal pores?). The gizzards are now said to be three in xiv to xvi, though in figure 10 the gizzards

are in xiii to xv while "in another specimen, probably not *M. Barwelli* they are further back" (p. 13). The setae differ greatly in size. There are dorsal pores (!). Septa 5/6 to 8/9 are thickened. The hearts are in vi to xiv (!). The sperm sac (= testis sac) is either in ix or x or in 9/10. No trace of ovaries could be discovered. In figure 1 (pl. 25) the male pores are shown as short transverse slits on transversely oval, postsetal areas on x. In figure 7 of the same plate the prostomium is ventral to the mouth and the "supra-oesophageal ganglion" is ventral to the gut (!), or else the setae are dorsal! In figures 8 and 10 segment xi is represented as normal, *i.e.*, uncontracted to form the ovarian chamber.

The absence of an ovarian chamber and of ovisacs definitely indicates that the types were not sexually mature, while Beddard's failure to find ovaries and free ova almost as certainly shows that the types were very juvenile. In specimens too young to show rudiments of ovaries, ova, ovarian chamber or ovisacs it is scarcely probable that the male pores would be recognizable as definite apertures. At this stage they are usually represented by little more than tiny, translucent, greyish patches of the epidermis. The male porophores figured by Beddard may of course be the precociously developed rudiments of one of the invaginate types of male genital terminalia but more probably represent genital markings. At any rate there is no certainty as to what is represented.

Furthermore, in specimens so young, it is also improbable that the prostates or the spermathecae would be sufficiently developed to enable recognition of the definitive specific characteristics of these structures. The sessile conformation of the prostates and the absence of spermathecal atria can be accepted as specific characteristics only if and when the specimens are mature.

In order to define a species in the genus *Drawida* the following characteristics must be known: setal relationships, location of the male pores and characteristics of the male genital terminalia, position of the spermathecal pores, number and location of the genital markings, length of the vas deferens, shape of the central body of the prostate, type of ovarian chamber, type of genital marking glands, extent of ovisacs and characteristics of the spermathecal atria. As against this requirement, we know only that in *D. barwelli* the anterior setae are enlarged, that the spermathecal pores are in 7/8 in *cd*, and that possibly there may be two genital markings on the postsetal portion of x. None of these characteristics is of much significance except in combination with others much more important. We can be certain at present,



therefore, only of the type locality and that the specimens are referable to the genus *Drawida*. Nothing further is known of the Moniligastrid fauna of the Philippines. The species can be recognized only after the collection and study of adult topotypes.

It is at least probable that later worms referred to *D. barwelli* have had little more in common with the types of this species than a similar state of youth in which adult and hence definitive specific characteristics cannot be determined.

#### DRAWIDA LONGATRIA Gates

*Drawida longatria* Gates 1925, Ann. Mag. Nat. Hist. ser. 9, 16, p. 50. (Type locality, Rangoon, Burma. Type in author's collection.)

*Moniligaster straeleni* Michaelsen 1930, Med. K. Nat. Mus. Belg., 6, no. 2, p. 1, and Mem. Mus. Hist. Nat. Belg., Hors Series, 2, fasc. 5, p. 4. (Type locality, Palembang, Sumatra.)

*Material examined*.—From the Hamburg Museum, one softened specimen labelled, "V 11641. *Moniligaster straeleni* Mich. v. Straelen. Sumatra." This specimen, probably one of the types, had been opened and some of the internal organs, including one of the prostates, removed from the anterior end.

The male propore, aside from the relaxation due to softening, is exactly the same as that on the types of *D. longatria*. On xii, in *bc*, there is a characteristic *longatria* genital marking.

The prostate is spirally coiled. The vas deferens passes into the extreme ental end of the prostate or very close thereto.

*Remarks*. *M. straeleni* cannot be distinguished by any characteristics of specific importance from *D. longatria*. Furthermore, the extremely elongate and slenderly tubular but simple spermathecal atria of *longatria* are quite unlike the bifid, muscular atrium, with its lobulated glandular masses, that alone distinguishes *Moniligaster* from *Drawida*.

#### Genus PHERETIMA Kinberg

*Pheretima* Kinberg 1867, Ofv. Akad. Förh., 23, p. 102. (Genotype, by subsequent designation — Michaelsen, 1907, *Pheretima montana* Kinberg 1867.)

A word of explanation may be necessary with regard to the terminology used in connection with the spermathecal apertures in this

genus. The primary spermathecal pore, regardless of size, is considered to be the aperture by which the united canals of the diverticulum and the duct open to the exterior. This primary pore may be superficial, *i.e.*, at the surface of the body, or invaginate, *i.e.*, within a parietal invagination. The invagination may be confined to the body wall or may be more or less conspicuously protuberant into the coelom. If superficial the pore may be minute as in *P. diffringens* (Baird) 1869 or large as in *P. philippina* (Rosa) 1891. If invaginate the pore is usually minute.

The size of the primary pore and its method of opening to the exterior directly or indirectly through an invagination is not subject to intra-specific variation. In absence of information with regard to these points, a species cannot be fully diagnosed.

#### PHERETIMA BIFIDA spec. nov.

*Material examined.*—From the Mus. Comp. Zoöl., 1 clitellate (no. 1) and 1 partially clitellate specimen (no. 2) labelled, "Ugi, Solomon Islands. W. M. Mann. No. 2027." and 2 clitellate specimens (nos 3 and 4) labelled, "Paiua, Ugi, Solomon Islands. W. M. Mann. No. 2028." All of these worms are brittle and coiled.

Length, about 100 mm. Diameter, 4 mm.

Setae are present on ii at least ventrally; the circle of xvi complete; no. 1, xvii/11, xviii/10, xix/16; no. 2, xvii/15, xviii/9, xix/12; no. 4, xvii/15, xviii/10, xix/14.

The clitellum extends from an anterior portion of xiv to the setae of xvi; on the partially clitellate specimen setae are present ventrally on xiv and xv.

The female pores are paired.

The spermathecal pores are minute and superficial; ten pairs, two pairs each in 4/5-8/9; the pores of a pair 1-2 intersetal intervals apart, the median pores of a furrow separated by a midventral distance equal to 6 to 8 intersetal intervals. On the clitellate specimen (no. 1) the lateral pore of the right side of 8/9 is lacking. On no. 4 one pore is lacking on the left side of 4/5 but there is an extra pore in 7/8 on the same side.

The male pores are minute and superficial, at the centres of transversely oval, smooth, small areas in the setal circle of xviii. Each male porophore is immediately preceded and followed by a transversely placed, slightly tumescent, whitish area, rather crescentic in shape with the concave side of the crescent facing the male porophore. The

appearance of the male pore region is somewhat similar to that of *Megascolex mauritii* (Kinberg) 1867.

The genital markings are transversely oval, paired, and presetal; on xi, xii, xvii, xix and xx (nos 1, 2 and 4). Each marking is about 2 intersetal intervals wide transversely, the preclitellar markings separated by a midventral distance equal to 2-3 intersetal intervals, the postclitellar markings by a distance equal to 5-9 intersetal intervals. On no. 4 there is an extra presetal marking on xxi on the right side. Specimen no. 3 appears to be abnormal. The left male porophore is nearly normal but the right porophore does not appear to be normally developed; the body wall is however eroded in this region. Both pairs of preclitellar genital markings are present but of the postclitellar markings there are only two, one on xvii on the right side and one on xx on the left side.

Septum 8/9 is lacking; 9/10 present but thin; 10/11 to 12/13 thickly muscular.

The intestine begins in xv (2). The intestinal caeca are simple, very short, in xxvi-xxv or xxvi-xxiv; bluntly rounded anteriorly.

The last pair of hearts is in xii (2). The single heart of ix is on the left side (2). The hearts of x are not closely bound to the anterior face of 10/11. The hearts of xi are not included within the testis sac.

The testis sac of x is U-shaped, the limbs of the U not attached to 10/11 nor enclosing the hearts of x and remarkably like seminal vesicles in their appearance. The testis sac of xi is also U-shaped, the limbs of the U reaching into the dorsal half of the segment but not to the dorsal blood vessel. The seminal vesicles of xi are included within the testis sac and surrounded by testicular coagulum. In no. 4 the vesicles are narrowed dorsally to a rod-like appendage which is curved down on itself and entirely concealed within the testicular coagulum. On the ventral margin of each of the seminal vesicles of xii is a cleft that passes dorsally, the rather slenderly columnar portion of the vesicle thus cut off is softer than the other portion of the organ and is attached by its ventral end to the posterior face of 12/13 just behind the ovary. The prostates are in xviii to xxi or xxii. The duct is C-shaped with a tiny ental quirk; thickened ectually.

The spermathecal duct is not markedly narrowed as it passes into the parietes and is shorter than the ampulla. The diverticulum passes into the body wall on the anterior face of the duct and into the duct just within the parietes, does not reach entally much beyond the middle of the ampulla and is very slenderly club-shaped. A seminal

chamber is not definitely marked off externally though the iridescence of the ental portion indicates that spermatozoa are present.

No glandular material is visible in the coelom in the region of the genital markings, the longitudinal musculature apparently uninterrupted.

*Remarks.* *P. bifida* is distinguished from *P. bleckwenni* Ude 1925 by the presence of two additional pairs of spermathecal pores located in 4/5, the greater size, the shortness of the clitellum, the completeness of the setal circle of xvi, the paired female pores, the numerous genital markings and their location, the absence of the hearts of xiii, and the inclusion of the anterior seminal vesicles within the posterior testis sac.

#### PHERETIMA CALIFORNICA Kinberg

*Pheretima californica* Kinberg 1867 (part), Ofv. Akad. Förh., 23, p. 102. (Type locality, Sausalita Bay, California. Type and two paratypes from San Francisco in the Stockholm Museum.)

*Material examined.*—From the U. S. Nat. Mus., 1 clitellate and 1 acitellate specimen labelled, "Atuona Vall. Hivaoa. Marquesas Is. 200 ft. III.28 29. Mumford and Adamson collectors." Both specimens, from the Pacific Entomological Survey, are macerated. From the same museum, 3 clitellate specimens labelled, "Sao Paulo, Brazil. Moenkhaus. '97 or '98. No. 1318."

Length, about 100 mm. Diameter, three to five mm.

The setae begin on ii on which segment there is a complete circle. Setae formulae are as follows: — 38/viii, 49/xii, 52/xx; viii/17, xvii/22, xviii/15, xix/23; viii/17, xvii/17, xviii/13, xix/17: 44/viii, 57/xii, 61/xx; viii/19, xvii/24, xviii/17, xix/23: 39/viii, 56/xx; viii/15, xvii/19, xviii/12, xix/18: 35/viii, 51/xx; xvii/19, xviii/14, xix/17.

The first dorsal pore is in 11/12 (5).

The spermathecal pores are minute and superficial; two pairs, in 7/8-8/9.

The male pores are minute and invaginate. The apertures of the male parietal invaginations are transversely slit-shaped, the evaginations in various stages of eversion, probably in none of the specimens fully retracted. With full eversion the minute male pore is visible at the centre of a smooth, circular, disc-shaped area at the ventral end of a columnar protuberance about one half mm in diameter.

There are no genital markings.

Septa 8/9-9/10 are lacking; from 10/11 to 14/15 the opacity of the septa decreases gradually but even 10/11 is not very thick.

The intestine begins in xv. The intestinal caeca are simple, with septal constrictions and one to eight very short lobulations of the ventral margin posteriorly.

The single heart of ix is on the left side in four specimens; the remaining specimen with a pair of hearts belonging to ix. All hearts of ix to xiii pass into the ventral blood vessel; the last hearts in xiii in all five specimens. The hearts of x to xiii are bound by connective tissue to the anterior faces of septa 10/11-13/14.

The testis sacs of x and xi are unpaired and ventral. The ventral blood vessel is imbedded in the roofs of these sacs. The prostates are in xvii-xix. The prostatic duct is nearly straight or bent variously. Ectally the duct narrows and close to the parietes is bent into several short quirks which are covered over and concealed by connective tissue in such a way as to produce an appearance of a small copulatory chamber slightly protuberant into the coelom. In none of these specimens do the male invaginations actually protrude into the coelom, possibly as a result of partial relaxation and protrusion.

The spermathecal duct is shorter than the ampulla but its coelomic portion is actually about twice as long as at first appears, as a result of invagination into the ampulla. The duct increases in thickness passing ectally, attaining its greatest diameter at the point of entrance of the diverticulum and is then narrowed as it passes into the parietes. The diverticulum is elongately tubular, with little if any external evidence of differentiation into stalk and seminal chamber, variously coiled or looped, passing into the duct close to the parietes. In the gelatinized Marquesas specimens the seminal chamber can be distinguished by the iridescence of the contained spermatozoa while the shorter stalk portion can be recognized by its muscular sheen. It is worthy of especial note that the diverticula of the spermathecae of the acelitellate Marquesas specimen are characterized by an iridescence that usually indicates the presence of spermatozoa.

#### PHERETIMA CALLOSA spec. nov.

*Material examined.* From the U. S. Nat. Mus. 1 clitellate specimen labelled, "Luzon, Benguet Province. P. I. Heights in the Oaks. Alt. 7,000 feet. E. A. Mearns. July 1907. No. 47782."

Length, 330 mm. Diameter, 16 mm.

The setae begin on ii on which segment there is a complete circle; 71/viii, 94/xii, 114/xx; vii/21, viii/23, xvii/23, xviii/13, xix/26.

The first dorsal pore is in 12/13.

The clitellum is annular and extends from 13/14 to 16/17. There are no setae. There is a single female pore on xiv.

The spermathecal pores are superficial, large, transverse slits with swollen margins, nearly 1 mm in width; three pairs in 6/7-8/9.

The male pores are invaginate, the apertures of the copulatory chambers transversely slit-like.

There are no genital markings externally.

Septum 8/9 is, apparently, represented only by a thin, transparent, ventral rudiment; 10/11-13/14 are thickly muscular; 9/10 lacking.

The intestine begins in xv. The intestinal caeca are simple, the margins smooth except for septal constrictions.

There is a pair of hearts belonging to ix. The last pair of hearts is in xiii. All hearts of ix to xiii pass into the ventral vessel.

The testis sacs of x and xi are paired and ventral. The seminal vesicles of xi and xii are relatively small, vertical bodies with a dorsal portion constricted off from the ventral lamina, the two parts of about the same diameter. The pseudovesicles of xiii are almost as large as the seminal vesicles. The pseudovesicles of xiv are fairly well developed but are smaller than those of xiii. The prostates are, relatively, rather small and are confined to xviii. The duct is straight and three to four mm. long. It passes into the roof of the copulatory chamber towards or at the median margin. The copulatory chambers are large and conspicuously protuberant into the coelom. The chamber is elongately ovoidal and easily separated, except for an anteroposteriorly flattened neck which passes to the external aperture, from the longitudinal muscular layer, within which it is partially imbedded. From the roof of the chamber there hangs down into the lumen a thickly conical penis which is about 2 mm long. The dorsal portion of the penis is firm and contains the ectal end of the prostatic duct. The ventral portion of the penis is soft and with a collapsed, flattened appearance. The tip of the penis is rather deeply cleft into two major lobes, one lateral and one median, the ventral margin of the lateral lobe marked off into three smaller lobules. The male pore has not been identified definitely but is probably represented by a small pore located in the dorsalmost portion of the cleft between the two major lips. On the anterior wall of the chamber as well as on the posterior wall there is a wide, horizontal cleft or slit at the anterior or posterior terminus of which is a circular, rather indistinctly delimited, slightly tumescent area bearing at its centre a small, slit-like to oval pore. This aperture leads into a small cavity within the thick mass of tissue that comprises



the anterior or the posterior wall of the copulatory chamber. The wall of the cavity is provided with slight rugosities and the lumen is lined with cuticle.

The spermathecal duct is stoutish and the wall is thick. The parietal portion is not narrowed and is provided with vertical rugosities internally. The coelomic portion is not sharply marked off from the longer ampulla. The diverticulum passes on the anterior face of the duct into the parietes and deep within the body wall into the duct. The diverticulum is looped in a zigzag fashion, the loops very short, the limbs of the loops in contact and bound together by connective tissue. A stalk portion is recognizable by its muscular sheen but externally is not sharply marked off from the seminal chamber which is longer than the stalk and very gradually and only slightly widened passing entally. The seminal chamber can be recognized by the iridescence of the contained spermatozoa which are present not only in the rather ovoidal terminal portion but also in one or two of the entalmost loops. The ental end of the diverticulum just reaches up onto the ampulla, and even after the loops are straightened out scarcely reaches to the tip of the ampulla. The spermathecal ampullae are filled with a whitish, flocculent material in which there are fine particles of soil. In a spermatheca which was opened there are in addition, in the ampulla, four, hard, reddish-translucent, pear-shaped objects.

*Remarks.* Segment xiv is filled with a brownish, granular material which does not appear to be aggregated into "brown discs." There are parasitic cysts in or on the walls of the ampullae or diverticula of all of the spermathecae.

The glands in the anterior and posterior walls of the copulatory chambers are like similarly placed glands in the copulatory chambers of *P. indica* (Horst) 1883, *P. montana* Kinberg 1867 and *P. philippina* (Rosa) 1891.

*P. callosa* is distinguished from *P. philippina* which it closely resembles by the larger size, the larger setal numbers, the rudimentary condition of septum 8/9, the vertically cleft tip of the penis and the binding together of the loops of the spermathecal diverticula.

#### PHERETIMA COPULATA spec. nov.

*Material examined.* From the Mus. Comp. Zoöl., 1 clitellate specimen labelled, "Ugi, Solomon Islands. W. M. Mann. No. 2026."

Length, ca. 80 mm. Diameter, 4 mm.

Setae are present on ii, at least ventrally; vi/3, vii/4, viii/5, xvii/8, xviii/4, xix/9, 4/xiv, ca. 15/xv, ca. 25/xvi.

The clitellum extends over segments xiv-xvi; setae are present on all segments ventrally; female pores paired.

The spermathecal pores are minute, transverse slits, slightly depressed but apparently superficial; four pairs, in 5/6-8/9, rather closely paired; the margins of the segments immediately about the pores slightly tumescent.

The male pores are tiny, transverse slits on the slightly protuberant and teat-like, central portions of transversely oval, whitish, glandular areas that extend nearly to 17/18 and 18/19. Each area is marked off by a slight circumferential furrow and is very slightly protuberant.

The genital markings are transversely oval and presetal, each marking with a rather broad rim sharply demarcated from a small and transversely oval central portion; two pairs, on xx and xxi. The markings are 5-7 intersetal intervals wide transversely and are separated from the opposite member of the pair by a midventral space equal to 4-7 intersetal intervals.

Septum 8/9 is lacking; 9/10 is present and rather thickly muscular.

The intestine begins in xv. The intestinal caeca are simple, in xxvii-xxiii.

The last pair of hearts is in xiii. The hearts of x are not bound closely to 10/11. There is a pair of hearts in ix.

The testis sacs of xi are ventral, paired and completely separated from each other midventrally. Each seminal vesicle of xii is provided at one side with a dorsal, rodlike appendage. The prostates are in xvii-xviii or xvi-xix. The duct is straight or slightly crescentic.

The spermathecal duct is stoutish, shorter than or about as long as the ampulla and sharply marked off therefrom. It passes into the parietes near the nerve cord without marked decrease in thickness. The diverticulum which is shorter than the duct is composed of a very short stalk and a longer, ovoidal seminal chamber and passes into the duct just at or just within the parietes. In segments vi and ix the spermathecal diverticula are simple, but in vii and viii an ental portion of each seminal chamber is constricted longitudinally so that the terminal part of the chamber is double. The appearance is very similar to that of the diverticulum of *P. zonata* Michaelsen 1922 (Cap. Zoöl. Deel, 1, Af. 3, p. 43, fig. 13).

There is no glandular material visible in the coelom in the region of the genital markings, the longitudinal musculature apparently uninterrupted.

*Remarks.* A number of more or less closely related, octothecal, metandric species of *Pheretima* with spermathecal pores in 5/6-8/9 have been erected. Of these, four species, *neoguineensis* (Michaelsen) 1892, *badia* Ude 1932, *elberti* Ude 1932, and *swelaensis* Ude 1932 have no intestinal caeca. The remaining species are all provided with simple intestinal caeca and from them *copulata* is distinguished as follows: from *papua* (Rosa) 1898 by the absence of preclitellar genital markings, the presence of postclitellar genital markings, the presence of 9/10 and possibly by differences in the spermathecal diverticula; from *spectabilis* (Rosa) 1898 by the presence of postclitellar genital markings, the presence of 9/10 and the stalked spermathecal diverticula; from *spectabilis* Ude 1932 by the absence of 8/9, the presence of hearts in xiii and the paired testis sacs; from *pacifica* (Beddard) 1899 by the paired genital markings, the absence of 8/9, the presence of hearts in xiii and the bifid seminal chambers of the spermathecal diverticula; from *pacifica* Ude 1932 by the posterior intestinal caeca; from *gjellerupi* Cognetti 1914 by the absence of preclitellar genital markings, the presence of postclitellar genital markings and the simple spermathecal diverticula<sup>1</sup>; from *doormani* Michaelsen 1924 by differences in number and location of the genital markings, the absence of 8/9 and the presence of 9/10; from *vialis* Michaelsen 1924 by the presence of genital markings and the single diverticulum on each spermatheca; from *bryoni* Michaelsen and Boldt 1932 by the presence of genital markings, the absence of 8/9, the paired testis sacs and the small and bifid spermathecal diverticula; from *wetzeli* Ude 1932 by the closer pairing of the spermathecal pores, the presence of genital markings, the absence of 8/9 and the short stalk of the spermathecal diverticulum.

#### PHERETIMA DIFFRINGENS (Baird)

*Megascolex diffringens* Baird 1869, Proc. Zoöl. Soc. London, p. 40. (Type locality, Plas Machynlleth, Montgomeryshire, North Wales. Type in the British Museum.)

*Material examined.* From the Mus. Comp. Zoöl., 5 clitellate specimens labelled, "Nadirivatu, Fiji Islands. W. M. Mann." and 1 clitellate specimen labelled, "St. Helena, Uplands, S. Side. 22.7.34. T. Barbour," all macerated.

<sup>1</sup> In *gjellerupi* Ude 1932 the seminal portion of the spermathecal diverticulum is two or three chambered.

PHERETIMA ELONGATA (E. Perrier)

*Perichaeta elongata* E. Perrier 1872, N. Arch. Mus. Paris, 6, p. 124. (Type locality, "Peru." Type in the Paris Museum.)

*Material examined.* From the U. S. Nat. Mus., 11 clitellate specimens labelled, "Batoran, Luzon. Gustav Eisen. Leon Laglouize. No. 4553," and 6 clitellate specimens labelled, "Negros Island, P. I. Bashford Dean. No. 38683." The Batoran specimens are softened.

PHERETIMA ESAFATAE (Beddard)

*Perichaeta esafatae* Beddard 1899, In Willey, Zoöl. Res., Cambridge, part 2, p. 187. (Type locality, Esafate, New Hebrides. Holot ype, if still in existence, probably in the British Museum.)

*Material examined.* From the Mus. Comp. Zoöl., 1 clitellate specimen labelled, "Solomon Islands, Santa Cruz. W. M. Mann. No. 2076." From the U. S. Nat. Mus., 1 clitellate specimen labelled, "Teaotu, Hanavave Vall. Fatuhiva, Marquesas Is. 800 ft. ix.19.1930. Le Bronnec Collector," 1 acitellate specimen labelled, "Otomaha, Oomoa Valley, Fatuhiva, Marquesas Is.," 1 clitellate specimen labelled, "Koputukea, Uapou, Marquesas Is. xi.16.30," and 1 acitellate specimen labelled, "Vaikoa, Oomoa Vall. Fatuhiva, Marquesas Is. Aug. 29, 1930. 1600 feet. Le Bronnec Collector," all from the Pacific Entomological Survey. The M. C. Z. specimen is in good condition. The others are gelatinized.

Length, about 100 mm. Diameter, 4 mm.

The setae begin on ii. The setal formulae are as follows:— 57/-viii, 57/xii, 63/xx; viii/2, xvii/6, xviii/0, xix/7: viii/4, xvii/8, xviii/0, xix/7: viii/4, xvii/6, xviii/0, xix/7: viii/2, xvii/8, xviii/1, xix/6: viii/2, xvii/8, xviii/2, xix/9. The setae are small, closely and regularly spaced.

The first dorsal pore is in 11/12 in three specimens, on two of which this pore is definitely smaller than the pore in 12/13.

The spermathecal pores are minute, superficial, rather close to the midventral line; two pairs, in 7/8-S/9.

The male pores are superficial, tiny, transverse slits towards the median margins of transversely oval, whitish areas that are about five intersetal intervals wide transversely and which extend from the setal line to 18/19. The male pores are, accordingly, postsetal. Setae may be lacking ventrally on xviii to a point just lateral to the lateral margins of the male porophores (2 specimens). A midventral region including a posterior portion of xviii and the anterior portion of xix

may be deeply depressed, the lateral limit of the depression just beyond the lateral margin of the genital markings.

The genital markings are nearly circular, about two intersetal intervals wide and are located, on the Solomon Islands specimen, as follows: — a presetal pair each on ix and x, each marking in *bc*; on x on the right side, a presetal marking in *cd*; on xvii, one pair, each marking in *ac*; on 18/19 and 17/18 one pair each, markings just lateral to the lateral margins of the male porophores; on 19/20, three markings, two median in the region *ad* and one on the left side in *fg*; on 20/21, two markings, each in *ad*.

The genital markings of the Marquesas specimens are few and recognizable only with difficulty. On the first of these specimens there is only a tiny, circular area on 19/20, on the right side and about in *bc*. On the second specimen there is a pair of markings on 19/20, each marking in *ac*. There are no genital markings on the third and fourth specimens. On the third specimen the male pore areas are shaped like four-leaf clovers and the margins are very definitely demarcated by massed flecks of a pigment that is lacking on the porophore.

Septa 8/9–9/10 are lacking; none greatly thickened.

The intestine begins in xvi, posteriorly in xv, or with 15/16. The intestinal caeca are simple, reaching into xxi, xx or xix; with two, three or seven very short lobes of the ventral margin posteriorly.

The single heart of ix is on the right side in three specimens, on the left side in one specimen. The last pair of hearts is in xiii (4 specimens). The hearts of x are not as closely bound to 10/11 as in *upoluensis*.

The testis sacs of both x and xi are paired and ventral. The seminal vesicles of xi are small and vertical and are excluded from the posterior testis sacs. The prostates extend through xvi or xvii to xviii. The prostatic duct is about three mm long, straight except for a tiny ental quirk concealed by connective tissue. The straight portion of the duct is spindle shaped. The duct appears to pass into the parietes just anterior to septum 18/19.

The spermathecal duct (Solomon Islands specimen) is not notably narrowed until deep within the parietes. The diverticulum passes into the duct just above the parietes and comprises a stalk with a muscular sheen bent into one or two very short loops, an indistinctly marked off, slightly wider, more or less moniliform middle portion that is slightly constricted off from a terminal, spheroidal seminal chamber.

In the Marquesas specimens the duct is  $1\frac{1}{2}$  to 2 times as long as the ampulla, stoutish, abruptly narrowed only deep within the parietes.

The diverticulum which passes into the middle portion of the coelomic part of the duct comprises a stalk with muscular sheen that is bent into one or two very short, close loops, a slightly wider, middle portion that lacks the muscular sheen and which is constricted off from a small, terminal, spheroidal seminal chamber (?) of about the same thickness as the middle portion. In the *Koputukea* specimen there is no spermatozoal iridescence in any of the spermathecae but the seminal chamber of each diverticulum is occupied by a yellow, transparent, hard, spheroidal body.

The genital marking glands are sessile on the parietes, the ducts confined to the body wall.

*Remarks.* The Vaikoo specimen is abnormal, lacking the prostates and the anterior pair of spermathecae. The posterior spermathecae are rudimentary.

Michaelsen (1913, p. 267) has suppressed both *csafatae* and *upoluensis* which are regarded as synonyms of *P. taitensis* (Grube) 1866. Our knowledge of all of these forms is very fragmentary. *P. upoluensis* (*q.v.* hereinafter) can probably be distinguished from *csafatae* by a number of characteristics which are too important and too numerous to be regarded as individual or even subspecific variations. The suppression of *upoluensis* cannot therefore be accepted, at least at the present time. There is even less justification for the suppression of *csafatae*. *P. taitensis* is known only from one type which has, apparently, never been dissected. The fusion of two species of earthworms, especially in the genus *Pheretima*, when the internal characteristics of one of the species are entirely unknown cannot be justified at present.

#### PHERETIMA HAWAYANA (Rosa)

*Perichaeta hawayana* Rosa 1891, Ann. Hofmus. Wien, **6**, p. 396. (Type locality, "Insel Haway." Types in the Vienna Museum.)

*Material examined.* From the Mus. Comp. Zool., 1 clitellate specimen labelled, "Nadarivatu, Viti Levu, Fiji Islands. W. M. Mann." From the U. S. Nat. Mus., 3 clitellate specimens labelled, "Sao Paulo, Brazil. Moenkhaus."

#### PHERETIMA INDICA (Horst)

*Megascolex indicus* Horst 1883, (part) Notes Leyden Mus., **5**, p. 186. (No type locality specified. Types from three localities in Sumatra and from Java. Types with copulatory chambers only.)



*Material examined.* From the Mus. Comp. Zoöl. 1 clitellate specimen labelled, "Moluccas, Obi Is., Lawoei. Thomas Barbour coll. 1906-07. No. 2030." and 1 clitellate specimen labelled, "Fiji Islands, Levuka, Ovalau. W. M. Mann. No. 2029." From the U. S. Nat. Mus. 1. clitellate specimen labelled, "Batoran, Luzon. P. I. Gustav Eisen. No. 4551."

Although this species is fairly old and was studied by Vaillant as far back as 1867 it has never adequately been characterized. A detailed description of specimens from Christmas Island and the Malay Peninsula is now in press.

### PHERETIMA LONGA (Michaelsen)

*Perichaeta longa* Michaelsen 1892, Arch. Naturg., **58**, 0. 239. (Type locality, Kepahiang, Sumatra. Holotype in the Berlin Museum.)

*Amyntas aeruginosus* Beddard 1900 (part), Proc. Zoöl. Soc. London, 629.

*Pheretima musica* Michaelsen 1900, (part), Das Tierreich, **10**, p. 287.

*Megascolex musicus* Horst 1883 (part), Notes Leyden Mus. **5**, p. 193. (Type locality, "High mountain forests, Java." Types in Leyden Museum. The type with simple intestinal caeca only.)

*Material examined.* From the Mus. Comp. Zoöl., an anterior fragment of a clitellate specimen and three juveniles labelled, "Java, Sindanglaia. Thomas Barbour coll. 1906-07. No. 2025." From the U. S. Nat. Mus., 1 incomplete, clitellate specimen labelled, "Soenoeng Boender, Mt. Salak. Java Exp. O. Bryant. May 1909.," 1 clitellate specimen labelled, "Soenoeng Boender, Mt. Salak, Java. May 1909. O. Bryant. No. 50556.," and 1 incomplete, a clitellate specimen labelled, "Buitenzorg. Java Exp. O. Bryant. 5-2 1909."

Length, 295+, 305+, 297, 130+ mm. Diameter, 17, 19, 18, 12 mm.

The setae begin on ii on which segment there is a complete circle; setae small, regularly and fairly closely spaced; a slight mid-dorsal break in the setal circles. The setal formulae are as follows:—viii/26, xvii/29, xviii/20, xix/28: 71/vii, 77/ix, 76/xiii; viii/27, xvii/29, xviii/22, xix/28: 89/xiii, 83/xvii, 87/xx; viii/22, xvii/21, xviii/17, xix/28: viii/26, xvii/32, xviii/21, xix/28. There are 90 setae on the penultimate segment of one specimen. The setae, on the Soenoeng Boender specimen, are located on narrow, unpigmented bands.

The first dorsal pore is in 12/13 (1 specimen) or 13/14 (3 specimens).

The spermathecal pores are superficial, small, less than one mm.

in width, transversely slit-shaped, crescentic or oval, widely separated; two pairs, in 7/8-8/9. On the two smallest juveniles the pores are represented only by greyish translucent areas of the epidermis.

The male pores are invaginate, the apertures of the invaginations roughly circular to transversely slit-shaped,  $2\frac{1}{2}$  to 3 mm wide, the margins of the apertures tumescent but firm and finely wrinkled.

There are no external genital markings.

Septa 8/9 and 9/10 are lacking; septum 10/11 is very thin and in some specimens cannot be traced mesial to the hearts of x; 11/12-13/14 are thickly muscular. The seminal vesicles of xi are closely bound by connective tissue to both 10/11 and 11/12. Included within this connective tissue are the hearts of x and xi.

The intestine begins in xv. The intestinal caeca are simple and placed fairly high up in the coelom, the margins smooth except for septal constrictions.

There is a pair of hearts belonging to ix in three specimens but in one of these the right heart is smaller than the left. In one specimen there is a single heart belonging to ix, on the right side. The last pair of hearts is in xiii (4 specimens).

The testis sacs of x and xi are paired and ventral, the sacs of a pair rather widely separated midventrally. The seminal vesicles of xi and xii are rather small, relative to the size of the worm, the anterior vesicles bound to the septa by connective tissue, the posterior vesicles free. The prostates are also small and are confined to xviii except in one specimen where the prostate of one side projects slightly into xvii. The prostatic ducts are short, straight or spirally coiled. Ectally the duct appears to be thickened, almost in a conical fashion and to lack the muscular sheen but this appearance is due to the presence of connective tissue around the ectal portion of the duct. Removal of this tissue shows the duct passing directly into the body wall without intervention of a copulatory chamber. There are no glands visible in the coelom or on the parietes. The invaginations within which the male pores are contained are large and deep. The male pore is on the roof of the invagination on a small, slight protuberance that may be disc-shaped, hemispheroidal or broadly conical. On the posterior wall of the invagination there is a vertically placed, hemi-ovoidal, hard protuberance or genital marking the ventral end of which may be visible from the exterior when the aperture gapes open. The surface of the marking is smooth and glistening.

The invagination of one side of one specimen is everted and the tissues at the surface of the everted portion are eroded.

The spermathecal duct (coelomic portion) is much shorter and slenderer than the ampulla into which it may be invaginated. The duct is not narrowed as it passes into the parietes and may even be considerably widened within the body wall. The diverticulum is elongately tubular, without external demarcation into a stalk or seminal chamber, slightly flattened ventrally, more nearly circular in cross section dorsally, apparently thickwalled but this appearance probably due, to some extent at least, to the characteristics of the seminal mass within. The diverticulum may be spirally coiled, zig-zag-looped or twisted irregularly into a compacted mass of loops and straightened out may have a length of 35 mm. The diverticulum passes into the parietes on the anterior face of the duct and at this point may be thicker than the duct. The aperture by which the diverticulum opens into the lumen of the duct is recognizable on the anterior wall after the duct has been slit open.

The largest of the juvenile specimens is 200 mm long and 14 mm thick. The setal formula is: viii/29, xvii/26, xviii/23, xix/30. The first dorsal pore is in 12/13. The male pores are not recognizable but on xviii on each side, in the setal circle, there is a transversely oval, slightly depressed, smooth area on which setae are lacking and on which the male pores are doubtless to have been developed. The spermathecal pores are recognizable as patent apertures, circular, minute, the portion of the epidermis on which the pore is located slightly depressed.

The prostates have not begun development but the seminal vesicles of both xi and xii are recognizable, the anterior vesicles already bound by connective tissue to 10/11 and 11/12. The spermathecae were not at first visible but after removal of coelomic coagulum from the floor of the coelom, four deep, well-like invaginations in the parietes with smooth margins were noted from which the tips of the ampullae of the rudiments of the spermathecae just barely project into the coelom. There are numerous small, brownish, spheroidal bodies, possibly of a parasitic origin, in the coelom of this specimen.

In one of the clitellate specimens there are brownish, disc-like bodies within the pseudovesicles of xiii and xiv. In another mature specimen the pseudovesicles of xiii each consist of a thin, translucent, membranous, dorsal sac and a slender but firm, vertical, ventral stalk by means of which the sac is attached to the posterior face of 12/13. Within each sac is a flattened "brown disc." That of the left side is 4 mm long and  $2\frac{1}{2}$  mm wide. The disc of the right side is smaller, only about  $1\frac{1}{2}$  mm long. The left sac ruptured as soon as it was

touched releasing its disc into the coelom. The pseudovesicles of xiv also contain "brown discs," smaller than those in xiii.

At least two of the mature specimens are heavily parasitized. In one of these specimens there are numbers of cysts in the parietes, each cyst ovoidal and two to three mm long. In addition there are in the coelom much larger numbers of smaller, whitish cysts. The second specimen is also characterized by the presence of these coelomic cysts but in addition there are a number of larger cysts also free in the coelom. Each of these cysts is spheroidal and transparent but with opaque, whitish material suspended in the cystic fluid.

*Remarks.* In *P. longa*, according to Michaelsen, the intestinal caeca are simple (einfache) while in *P. musica*, according to Horst, "the intestine is provided on each side of the 26th segment with six caeca of which the superior is the longest" as in *P. schmaridae*. Rosa (1894), after examination of a single specimen from Java which was believed to be intermediate between Horst's and Michaelsen's specimens, suppressed *longa*, a procedure which was accepted by Michaelsen in 1900. Rosa, unfortunately, was unable to determine the characteristics of the intestinal caeca of his specimen and may, perhaps, have been influenced unduly by the fact that one of Horst's types of *musica* had only one pair of intestinal caecae. It is, however, extremely unlikely that any species of *Pheretima* is characterized by both simple and compound intestinal caeca. Accordingly *longa* must be reinstated. Further differences between the two species will doubtless be evident after reexamination of the types.

Horst's specimen of *P. musica* with simple intestinal caeca must be abnormal or specifically distinct from *musica* and in the latter case is probably referable to *P. longa*. There is no evidence on record to show that simple intestinal caeca may be present as an abnormality in species characterized by compound, glove-shaped caeca.

#### PHERETIMA MONTANA (Kinberg)

*Pheretima montana* Kinberg 1867, Ofv. Förh., **23**, p. 102. (Type locality, "Tahiti." Type in Stockholm Museum.)

*Material examined.* From the U. S. Nat. Mus., 1 clitellate specimen labelled, "Tehue, Vaitaku Vall. Tahuata, Marquesas Is. May 27, 1930. 750 feet. In dead log. Le Bronnee and H. Tauraa Coll. No. 13 Olson. *P. posthuma*." 1 clitellate specimen labelled "Vaituha Valley. Eiao Marquesas-Is. Oct. 3 1929. 100 feet. In damp earth under stone. A. M. Adamson Coll." 1 clitellate specimen labelled "Coconut Plantation Mohotani.

Marquesas Is. 700 + + I.31.31. Under dead log. Le Bronnee and H. Tauraa Coll.," 5 clitellate specimens labelled, "Mohotani, Marquesas Is. 700 feet. II.2.31. In soil. Le Bronnee and H. Tauraa Collectors.," and 1 partially clitellate specimen labelled, "Atuona Vall. Hivaoa. Marquesas Is. 200 feet. III.28.29. Mumford and Adamson Collectors.;" all from the Pacific Entomological Survey. The specimens are considerably softened.

Length, 80 to 100 mm. Diameter, 5 mm.

The setae begin on segment ii. The setal formulae are as follows: viii/18, xviii/7; viii/11, xvii/13, xviii/?, xix/15; viii/13, xvii/15, xviii/2, xix/15; viii/10, xvii/12, xviii/0, xix/11; viii/10, xvii/12, xviii/4, xix/14; viii/11, xvii/13, xviii/0, xix/14.

The first dorsal pore is in 11/12 or 12/13.

The spermathecal apertures are minute, crescentic or transversely slit-shaped, superficial, the margins of the apertures slightly tumescent; one pair, in 7/8.

The apertures of the copulatory chambers are large, roughly circular, gaping doubtless as a result of the maceration. On one specimen the anterior portion of a copulatory chamber is everted as a conspicuously protuberant, pear-shaped, smooth body. The tip of the penis is just barely visible at the base of the protuberance.

There are no external genital markings.

Septum 8/9 is present but membranous.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiv, xxiii or xx. The ventral margin posteriorly is provided with two to six very short lobes.

The last pair of hearts is in xiii (7 specimens). All hearts of ix to xiii pass into the ventral vessel.

The testis sacs of both x and xi are paired and ventral, the sacs of a segment fairly widely separated. The seminal vesicles of xi and xii are small, flattened, leaf-like bodies. Each vesicle is continued dorsally into a digitiform appendage. The prostate is usually in two widely separated lobes, one lobe in xvii and one in xix but either lobe may project slightly into xviii. In one specimen the prostate on the left side is in one continuous mass from which emerge five ductules that very shortly unite to form the muscular duct. The right prostate in this same specimen is in two distinct lobes. From the middle portion of the copulatory chamber arises a conspicuous, finger-shaped, laterally directed protuberance, the penis sac. This sac usually separates the two lobes of the prostate from each other. The short prostatic duct which is two to three mm in length (coelomic portion) passes into the base of the penis sac on the dorsal or median face near



the copulatory chamber. The wall of the penis sac is transparent so that the glistening prostatic duct is visible throughout its entire course to the ental end of the sac where it turns and passes into the ental end of the penis. In a considerable portion of its course through the penis sac the prostatic duct is very narrow and looped back and forth in a rather zigzag fashion. The penis is slenderly tubular, eight to nine mm in length. The copulatory chamber, from the dorsal side, has an elongately hemiovoidal appearance. The chamber reaches into xvii and xix, the portions of the chamber in these two segments not constricted or marked off from the part in xviii. The anterior as well as the posterior portion of the chamber is mainly composed of a gland with a small lumen which opens posteriorly (or anteriorly) into the lumen of the chamber by a small, circular pore at the centre of a disc-like, almost circular marking. This marking may be more or less conspicuously protuberant into the lumen of the chamber. None of the chambers are everted in the specimens examined. However, a slow, steady pull on the cuticle at the aperture of the copulatory chamber will draw the penis out to the exterior at the same time everting the central portion of the chamber. In this artificially everted condition the chamber is represented externally by a mound-like protuberance into which the ental end of the penis passes. Viewed internally, a central portion of the roof of the chamber in xviii is very deeply depressed and into this depression there pass, side by side, the prostatic duct and the penis sac.

The spermathecal duct is long and slender, perhaps two to three times the length of the ampulla but this is not immediately apparent as the duct is zigzagged on itself while the loops thus formed are covered over and concealed by connective tissue. The ampulla is bent over and bound at one side to the duct. The diverticulum is short and small, comprising an ovoidal seminal chamber and a stalk which passes into the duct close to the ampulla.

*Remarks.* In the Eiao specimen the left copulatory chamber is in xix rather than xviii.

The partially clitellate Atuona Valley specimen differs from the other worms as follows. The spermathecal duct is fairly short and straight, *i.e.*, not looped. No penis sacs are visible in the coelom of xviii but from the roof of the copulatory chamber there hangs down within the lumen of each chamber a thickly columnar body with a flat ventral end of circular outline. At the centre of the ventral end is a tiny pore. Within the columnar protuberance is a slenderly tubular penis about two mm in length.



## PHERETIMA MORRISI (Beddard)

*Perichaeta morrissi* Beddard 1892, Proc. Zoöl. Soc. London, p. 166. (Type locality supposedly Penang, but types imported to Kew Gardens. Supposed types in the British Museum are from Hongkong.)

*Material examined.* From the Mus. Comp. Zoöl., 1 specimen labelled, "St. Helena, Uplands, S. Side. 22.7.34. T. Barbour." From the U. S. Nat. Mus. 4 clitellate specimens labelled, "Isle of Pulo Penang. E. Deschamps. No. 41273." The M. C. Z. specimen is macerated.

## PHERETIMA PEGUANA (Rosa)

*Perichaeta peguana* Rosa 1890, Ann. Mus. Genova, **30**, p. 113. (Type locality Rangoon, Burma. Type in the Genoa Museum.)

*Material examined.* From the Hamburg Museum: 14 specimens in a tube labelled "V 9284 *Pheretima peguana* (Rosa). Java, Tandjong Prick Buitendyk. Mus. Leyden;" 1 specimen in a tube labelled "V 9308 *Pheretima peguana* (Rosa). Siboga Exped. Lombok Bay v. Labuan. Mus. Leyden.;" 1 specimen from a tube labelled "V 3052 *Pheretima peguana* (Rosa) Schwinghammer. Saigon;" 3 specimens in a tube labelled "V 7051 *Pheretima peguana* (Rosa) W. Wöltung H. Christopher. Batavia." and four specimens in a tube labelled "*P. rodericensis* Gr. Saigon." From the British Museum: 4 specimens in a tube labelled "*Pheretima peguana*. 1904-10-5-1357-60 Penang. coll. Beddard.;" and 2 specimens from a tube labelled "*Perichaeta peguana*. 98-10-29-6. Chantaboon, Siam." From the Genoa Museum; one specimen in a tube labelled, "*Perichaeta peguana* Rosa, Ann. Mus. Civ. Genova, XXX, 1890, p. 113, T. I. f. 6-8. Typus! Rangoon, L. Fea. Cat. No. 46."

There is nothing of especial importance concerning the morphology of this worm to be added as a result of the examination of the type or of the other specimens. The species is distinct and has been adequately described. The distribution is curious: Lombok, Java, Borneo, Cochin China, Siam, Penang and Burma.

## PHERETIMA PHILIPPINA (Rosa)

*Perichaeta philippina* Rosa 1891, Ann. Hofmus. Wien, **6**, p. 397. (Type locality, "Insel Cebu." Types in the Vienna Museum. Known hitherto only from the types.)

*Material examined.* From the U. S. Nat. Mus. 1 clitellate specimen (No. 1) labelled, "V A18 Adodolay. Md X. Balabag Silay. Occ. Negros. 12/11/29. No. 109780." and 2 clitellate specimens (Nos. 2 and 3) labelled, "Negros Is. P. I. Bashford Dean. No. 38683."

Length, 197, 122 and 164 mm. Diameter, 7, 7 and 8 mm.

The setae begin on ii on which segment there is a complete circle. The setal formulae are as follows:— 36/viii, 57/xii, 53+/xx (wide dorsal gap); vii/7, viii/8, xvii/13, xviii/4, xix/16: vii/6 (+3?), viii/7 (+3?), xvii/13, xviii/6, xix/13: 40/viii, 54/xii, 64/xx; vii/9, viii/10, xvii/13, xviii/4, xix/13 (+1?). On ii-ix the setae are enlarged and conspicuously protuberant.

The first dorsal pore is in 12/13 but on one specimen there is a pore-like marking in 11/12.

The spermathecal pores are superficial, large, transverse slits nearly one mm in width; three pairs, in 6/7-8/9.

The male pores are invaginate, in copulatory chambers with large, roughly circular to transversely slit-shaped apertures slightly less than one mm in diameter, the margins of the apertures finely wrinkled and slightly tumescent. On no. 2 external to the wrinkled margin is a swollen zone which extends across 18/19 and 17/18, 18/19 lacking on the swollen areas. A copulatory chamber of no. 3 is partially everted and in such a way as to expose only the posterior wall of the chamber on which there is visible a rather mound-like protuberance of circular outline. At the centre of the protuberance is a small pit.

There are no external genital markings.

Septum 8/9 is present but thin and transparent (3 specimens); 9/10 lacking; 10/11-13/14 thickly muscular.

The intestine begins in xv. The intestinal caeca are simple and extend into xx or xxi. The margins are smooth except for septal constrictions.

The last pair of hearts is in xiii (3).

The testis sacs of x and xi are paired and ventral. Each seminal vesicle is narrowed gradually at the upper extremity into an elongately digitiform appendage. In no. 3 there is a pair of pseudovesicles in xiii. The prostates are relatively small, confined to xviii and rather crescentic in outline. The prostatic duct is two to three mm in length, U-shaped or almost straight and passes into the centre of the roof of the copulatory chamber. The latter is conspicuously protuberant into the coelom and is elongately ovoidal. From the roof of this chamber there hangs down in the lumen an elongate and slenderly conical penis. A ventral portion of the penis has a flattened, collapsed appearance and may be folded back onto the upper portion. On the median face of the penis is a very narrow, vertical groove, the margins of which are in apposition. On separation of these margins a pore,

presumably the male pore, becomes visible in the dorsalmost portion of the groove. On the anterior wall of the lumen and also on the posterior wall there is a conspicuously protuberant, hemispheroidal knob. At the centre of this knob there is a pit leading anteriorly (or posteriorly) into a small secondary lumen within the mass of tissue which forms the major portion of the anterior (or posterior) wall of the copulatory chamber. On the wall of the secondary lumen there are two to four tiny, whitish, conical or ridge-like protuberances.

The spermathecal duct (coelomic portion) is fairly thick, shorter than the ampulla, the lumen rather wide and the wall not strongly muscular but with slight vertical rugosities. In no. 2 and no. 3 the duct is covered with a macerated nephridial "fur" and is invaginated into the ampulla. The duct is not narrowed within the parietes. The diverticulum passes into the anterior face of the duct slightly ental to the parietes. The aperture of the diverticulum is recognizable as a minute pore on a slight elevation with a circular outline on the anterior wall of the lumen of the duct about half way between the external aperture and the opening into the ampulla. The diverticular stalk is slender and may reach to or even beyond the tip of the ampulla. The seminal chamber is spheroidal, ovoidal, pear-shaped or sausage-shaped and is less than one half as long as the stalk. In one specimen the diverticulum is much shorter than the combined lengths of duct and ampulla. In another specimen (no. 3) there are several slight sinuosities in the diverticular stalk.

*Remarks.* According to Rosa, septum 8/9 is lacking but this septum is so delicate and so transparent that it may have been unnoticed.

There are whitish cysts attached to the gut and body wall of no. 2. There is a large "brown disc" in the coelom of no. 1.

Although the external aperture of the spermatheca in this species is large, it is nevertheless the primary opening to the exterior of the combined canals of the diverticulum and duct. Hence the characterization in the preceding description of the spermathecal pores as superficial and large.

#### PHERETIMA POSTHUMA (L. Vaillant)

*Perichaeta posthuma* L. Vaillant 1868, Ann. Sci. Nat., Ser. 5, 10, p. 228. (Type locality, "Java." Types in the Paris Museum.)

*Material examined.* From the Am. Mus. Nat. Hist., 5 specimens labelled, "Takao, Formosa. Hans Sauter. 4.xi.07. No. A3473."

## PHERETIMA SANGIRENSIS (Michaelsen)

*Perichaeta sangirensis* Michaelsen 1891, Mitt. Mus. Hamburg, 8, p. 36. (Type locality, Sangir. Types in the Hamburg Museum.)

*Material examined.* From the Mus. Comp. Zoöl. two clitellate specimens labelled, "Moluccas, Halmaheira Is., Patani. Thomas Barbour coll. 1906-07. No. 2031."

The setae begin on ii on which segment there is a complete circle; viii/8-10, xvii/10-13, xviii/4-3, xix/11-13.

The spermathecal apertures are superficial, fairly large, transversely oval; one pair, in 7/8.

The apertures of the copulatory chambers are transversely slit-like and fairly closely paired.

Septa 8/9-9/10 are lacking.

The intestine begins in xv. The intestinal caeca are simple, with finger-shaped lobulations of the ventral margin.

The single heart of ix is on the left side. The last pair of hearts is in xiii.

The testis sacs of x and xi are paired and ventral, the sacs of a pair separated midventrally by the ventral blood vessel. The seminal vesicles are two pairs in xi and xii, the anterior vesicles excluded from the testis sacs of xi. The prostates are small but extend through xvii to xx. The prostatic duct is C-shaped or bent into a U-shaped loop with the limbs approximated, thickened ectally. The duct passes into the centre of the dorsal face of the copulatory chamber. The chambers are large and conspicuously protuberant into the coelom. From the roof of the chamber there hangs down within the lumen a conical penis about one mm in length. On the walls of a genital chamber there are two or three protrusions which may represent genital markings. No pores or glands connected with the supposed markings were seen, though the failure to recognize them may be due to the maceration which has taken place.

The spermathecae are in vii. The spermathecal duct is stoutish, rather barrel-shaped, nearly as thick and about as long as the ampulla, not notably narrowed within the parietes. The diverticulum comprises a small, ovoidal seminal chamber and a slender stalk of about the same length as the chamber. The latter is filled with spermatozoa. An ectal portion of the seminal chamber and the stalk are bound to the spermatheca by connective tissue. On cutting this tissue the diverticular stalk can be pulled out from a definite, vertical groove on the posterior face of the spermathecal duct. Near the parietes the stalk

passes deeper into the tissues of the duct. The spermathecal duct can be easily dissected out from the parietes and slit open to show a minute, conical papilla on the posterior wall of the lumen just anterior to the point of deeper penetration of the diverticular stalk. There are no further genital markings on the luminal wall of the duct though the wall is roughened, especially near the external aperture.

*Remarks.* In the coelom of the anterior end there are numerous, small, whitish cysts.

#### PHERETIMA SIEBOLDI (Horst)

*Megascolex sieboldi* Horst 1883, Notes Leyden Mus., 5, p. 191. (Type locality, "Japan." Type in Leyden Museum.)

*Material examined.* From the U. S. Nat. Mus. 1 acitellate specimen labelled, "Japan. Cyrus A. Clark. No. 39562."

Length, about 250 mm. Diameter, 11 mm.

The setae begin on ii on which segment there is a complete circle; 69/viii, 74/xi, 76+/xx; vii/27, viii/27, xvii/25, xviii/15, xix/23. The setae are small, regularly and fairly closely spaced.

The first dorsal pore is in 12/13.

The external apertures of the spermathecae are small and oval; three pairs, in 6/7-8/9.

On the right side the minute male pore is superficial and on a transversely oval, smooth area. On the left side the male pore is invaginate, on the roof of a slight depression with a transversely slit-like aperture. Anterior and posterior lips are slightly tumid.

There are no genital markings.

Septum 8/9 is represented only by a ventral rudiment; 9/10 lacking.

The intestinal caeca are compound, the dorsalmost secondary caecum the longest, but the ventral secondary caeca are almost as long. The secondary caeca are bound together for some distance anterior to the point of origin by connective tissue.

There is a pair of hearts belonging to segment ix. The hearts of x and xi are included within the testis sacs.

The testis sac of x is unpaired and U-shaped, the limbs of the U reaching dorsally to the dorsal blood vessel. The testis sac of xi is cylindrical and formed by a tough sheet of tissue which passes anteroposteriorly in a cylindrical fashion from 10/11 to 11/12 enclosing the gut and all the organs of the segment. The seminal vesicles of xi

are thus included within the posterior testis sac. The prostates are confined to xviii. The prostatic duct is almost straight.

The spermathecal duct is slightly shorter than the ampulla from which it is fairly sharply marked off and is abruptly narrowed, almost to a thread, in the upper portion of the parietes. The duct can be pulled out from the body wall leaving a tiny pit on the anterior portion of a flat, oval area that is slightly depressed within the parietes. The diverticulum, without coils or loops, passes into the anterior face of the duct just within or close to the parietes and extends entally to the middle of the ampulla or to beyond the ental end of the ampulla and shows only slight evidence externally of differentiation into stalk and seminal chamber.

*Remarks.* The male genital terminalia are, at least on the left side, not fully developed.

The organs of segments xii-xiv had been protruded through a dorsal rupture and damaged so that certain characteristics could not be determined.

#### PHERETIMA UPOLUENSIS (Beddard)

*Perichaeta upoluensis* Beddard 1887, Proc. Roy. Soc. Edinburgh, **14**, p. 174.  
(Type locality, "Upolu Island." Types, if still in existence, are probably in the British Museum.)

*Material examined.* From the Mus. Comp. Zoöl., 1 clitellate specimen labelled, "Fiji Islands, Vanua Levu, Wainunu. W. M. Mann. No. 2077."

Length, about 145 mm. Diameter, 5 mm.

The setae begin on ii on which segment there is a complete circle: 70/viii, 68/xii; viii/8, xvii/10, xviii/4, xix/10.

The first dorsal pore is in 12/13.

The spermathecal apertures are tiny transverse slits; two pairs in 7/8-8/9.

The male pores are exactly in the setal line and are not readily recognizable as there is, around the pores, no apparent epidermal modification. The apertures are tiny, transverse slits the margins of which are in apposition. A slight traction is necessary on the epidermis in the vicinity of the gaps in the setal circle to separate the margins and definitely demonstrate the presence of a pore. Immediately behind each male pore is a tiny genital marking which might be mistaken for a male porophore.

The genital markings are small, nearly circular, one to two inter-setal intervals wide, each with a protuberant rim and depressed centre.



The markings are located as follows: — a presetal, median marking on each of xviii and xix; a postsetal pair on xviii, immediately behind the male pores; a postsetal pair each on xvii and xix, the markings just median to the male pore lines; on the left side, a postsetal marking each on xiv, xv and xvi, each marking in line with the left postsetal marking on xvii; a postsetal pair on each of vii and viii, the markings immediately anterior to the spermathecal pores.

Septa 8/9–9/10 are lacking; 10/11–12/13 thickly muscular.

The intestinal caeca are simple and short.

The single heart of ix is on the right side. The hearts of x are bound to the anterior face of 10/11. The last pair of hearts is in xiii.

The testis sac of x may possibly be U-shaped but if so, the limbs are not filled laterally and dorsally with testicular coagulum. The testis sac of xi is U-shaped but the left limb is not normally developed. The hearts of xi are bound to the testis sac but are not included within it, at least in the dorsal half of the coelom. The seminal vesicles of xi are included within the posterior testis sac and are imbedded in the testicular coagulum. The prostates extend through xvii to xix. The prostatic duct is thick, almost straight but with an ental quirk which is concealed by connective tissue.

The spermathecal duct is not conspicuously narrowed as it passes into the parietes. The diverticulum comprises an ectal stalk portion with a muscular sheen, a middle, thinner-walled, more or less moniliform portion slightly wider than the stalk, about the same length as or shorter than the stalk, and a terminal portion, shortly ovoidal or conical and deeply constricted off from the middle portion. The diverticulum passes into the duct just at the parietes.

There are glandular masses protuberant into the coelom above the genital markings but the ducts of these glands are confined to the parietes.

The coelom of some of the post-prostatic segments is more or less filled with small, ovoidal to spheroidal, whitish, parasitic bodies. Similar bodies are also present in xiii and xiv.

*Remarks.* The original description of *P. upoluensis* is so incomplete that the species cannot be adequately characterized until the types have been reexamined. Although there is thus some doubt as to the identification of the specimen described above, the agreement with Beddard's description is sufficient to render inadvisable, at least for the present, the erection of a new species.

Assuming the identification to be correct, *P. upoluensis* can now be distinguished from *P. csafatae* by the location of the male pores in

the setal circle, the presence of unpaired, median, genital markings on certain segments, the unpaired testis sacs, the U-shape of the testis sacs at least of xi, and the inclusion of the anterior pair of seminal vesicles within the posterior testis sac.

In *upoluensis* the genital markings are segmental while in *csafatae* many of the markings may be intersegmental.

#### PHERETIMA species?

*Material examined.* One clitellate specimen from the U. S. Nat. Mus. labelled, "Japan. Rev. Cyrus A. Clark. No. 39562."

Length, about 70 mm. Diameter, 3 mm.

The setae begin on ii on which segment there is a complete circle; xvii/21, xviii/18, xix/18.

The first dorsal pore is in 12/13 but there is a pore-like marking in 11/12.

The male pores are minute, probably at the centres of disc-shaped porophores. Mesially but not laterally these porophores are depressed. On each disc are rudiments of tiny tubercles; one just anterior to, one just posterior to, and one just median to the male pore. Each of the two lateralmost male setae on each side is imbedded in a very small, whitish tubercle.

Aside from the markings just mentioned there are no other genital markings.

The intestine begins in xv. The intestinal caeca are compound, the dorsalmost secondary caecum the longest, the secondary caeca bound together by connective tissue.

There is a single heart belonging to segment ix, on the left side. No hearts belonging to x were found. The last pair of hearts is in xiii.

The seminal vesicles of xi and xii are rudimentary and flattened against the posterior faces of their septa. There is a pair of well developed (relatively) pseudovesicles in xiii. The prostates extend through segments xvi to xxi. The prostatic duct is bent into a U-shaped loop with the limbs of the loop in contact, the ectal limb thicker than the ental limb. The ducts of three coelomic glands pass into the parietes together with the prostatic duct.

There are no spermathecae.

*Remarks.* No parasites were to be seen either in the coelom or on the gut or the parietes.

The specimen is abnormal and possibly is to be referred to *P. yamadae* Hatai 1930. If this be correct the structures in the immediate vicinity of the male pores have not been completely developed.

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